

## CLAIMS

- 1) An automatic control and monitoring system for splice  
5 overlapping tolerance in textile ply, characterised by  
being composed of:
- a) Sub-system of image acquisition (2) containing the  
modules of lighting, artificial vision and respective  
support, fixing, conditioning and adjustment (3)  
10 elements;
  - b) Quality control computer program comprised of the  
following modules:
  - c) Morphological analysis of image for the detection and  
recognition of the overlapping of textile ply, detection  
15 and counting of threads or cords in the overlap area;
  - d) Support to the decision making process of  
acceptance/rejection of the ply based on the parameters  
defined by the user;
  - e) Interconnection with production equipment.
- 20 2) An automatic control and monitoring system for splice  
overlapping tolerance in textile ply according to claim 1,  
characterised by the lighting module being comprised of:
- a) A source of light (7), coherent or incoherent;
  - b) A casing to hinder the entrance of ambient light;
  - 25 c) A background surface (10) to originate an adequate  
contrast for the functions of identifying the  
overlapping region and counting of cords.
- 3) An automatic control and monitoring system for splice  
overlapping tolerance in textile ply according to claim 1,  
30 characterised by the fact that the lighting module has a  
uniform source of light or radiation.
- 4) An automatic control and monitoring system for splice  
overlapping tolerance in textile ply according to claim 1,  
characterised by the fact that the lighting module is  
35 constituted by a fixed or a sweeping beam.

- 5) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the lighting module is of collimated light.
- 5 6) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the lighting module is of structured light.
- 7) An automatic control and monitoring system for splice  
10 overlapping tolerance in textile ply according to claim 1, characterised by the fact that the lighting module is of visible, infra-red or ultra-violet light.
- 8) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1,  
15 characterised by the fact that the lighting module is of stroboscopic light.
- 9) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the lighting module is of  
20 polarised light.
- 10) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the lighting module is comprised of incandescent lamps, fluorescent lamps,  
-25- halogen lamps, lasers in solid state, gaseous lasers, laser diodes or light emitting diodes (LED).
- 11) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the lighting module has one  
30 or more sources of light or radiation positioned frontally to the textile ply or at an angle between  $-90^{\circ}$  and  $+90^{\circ}$ .
- 12) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the casing that hinders the  
35 entrance of ambient light has a set of partitions (6) duly

positioned to diminish the reflection of light lost in the walls of the referred casing.

- 13) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the casing that hinders the entrance of ambient light has diaphragms for the interception of incandescence.
- 14) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the casing that hinders the entrance of ambient light has, in the ply circulation slot, an external light barrier in the form of curtains or bristle bars or any other similar material.
- 15) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the background surface (10) is inclined at an appropriate angle, depending on the visual field of the referred camera, to diminish the retro-reflection of the referred background surface onto the mentioned camera.
- 16) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised for having a device for the detection of the thickness of the textile ply, either mechanic, electronic, optoelectric or another type, which enables to synchronise the release of the shutters of the video cameras with the passage of the overlapping splice region.
- 17) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the background surface has on the inner surface in the area of the ply circulation slot one or more marks that limit the observation area facilitating its identification by the computerised morphologic analysis program.
- 18) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1,

characterised by the fact that the module of artificial vision has a video camera or cameras (8) of the type CCD, with the following characteristics:

- a) interline transfer, frame, complete frame or other architecture;
- b) arrangement of points with in line or on area sweeping;
- c) spectrum of sensibility to one colour or to various colours in the visible, in the infra-red or ultra-violet spectrum.

19) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the module of artificial vision has a camera or cameras that function in synchrony with the lighting system of stroboscopic light.

20) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the module of artificial vision has a camera or cameras with polarising filters.

21) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the support, fixation and adjustment element of the image acquisition module is comprised of a mechanical assembly of an worm screw or other, manually activated or by an motor (9) controlled by the operator, or automatically.

22) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the quality control computer program has a morphological module of image analysis that enables the:

- a) Detection and recognition of the overlapping of the textile ply;
- b) Detection and counting of cords in the overlap area;
- c) Adjustment of detection in view of the colours and dimension of the ply, of the cords and of the rubber, by the operator or automatically.

- 23) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the quality control program has a decision module of acceptance/rejection of the ply that enables the user to define the parameters and criteria, as for example, the maximum and minimum number of faults or patterns of the ply batches with certain sequences of faults.
- 24) An automatic control and monitoring system for splice overlapping tolerance in textile ply according to claim 1, characterised by the fact that the quality control program has an interface module with the remaining production equipment that enables the interface with a programmable logic controller, PLC.
- 25) Utilisation of the automatic control and monitoring system for overlapping splice tolerance in textile ply according to the claims 1 to 24, in the tyre production industry.